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VHF Radar Sounding of Europa's Subsurface Properties and Processes: The View from Earth

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A primary objective of future Europa studies will be to characterize the distribution of shallow subsurface water as well as to identify any ice-ocean interface. Other objectives will be to understand the formation of surface and subsurface features associated with interchange processes between any ocean and the surface as well as regional and global heat flow variations. Radar sounding will be a critical tool for understanding these processes.

Airborne ice penetrating radar is now a mature tool in terrestrial studies of Earth's ice sheets, and orbital examples have been successfully deployed at Earth's Moon and Mars. Recent terrestrial examples include the University of Texas's High Capability Airborne Radar Sounder (HiCARS), the British Antarctic Survey's PASIN system, and the University of Kansas's IPR and MCords systems. Spaceborne demonstrations include NASA's Apollo 17's ALSE, JAXA's LRS system on the Kaguya lunar orbiter; as well as MARSIS onboard ESA's Mars Express, and SHARAD onboard NASA's Mars Reconnaissance Orbiter, which both operate at HF frequencies.

Many of the key scientific problems at Europa will require high resolution and global coverage to resolve, implying for the Jupiter system a system operating at a carrier frequency above 40 MHz to complement lower frequency sounders interrupted by Jovian emissions. We explore the challenges of such a system, including surface scatting, in the context of likely science targets and using recent Earth analog studies at 60 MHz using the HiCARS system to define the radar imaging approach for Europa's subsurface that will be useful for testing the hypotheses for the formation of major features.